

	Si				O				N				H				Compound	PECVD chemical reaction
	1	0	1	2	0	1	2	3	4	0	1	2	3	4	0	1		
Si compounds	X	X			X					X							-	-
	X	X			X							X					-	-
	X	X			X							X					-	-
	X	X			X								X				-	-
	X	X			X									X			-	-
	X	X			X										X		-	-
	X	X			X											X	-	-
	X	X			X												-	-
	X	X			X												-	-
	X	X			X												-	-
	X	X			X												-	-
	X	X			X												-	-
	X	X			X												-	-
	X	X			X												-	-
	X	X			X												-	-
	X	X			X												-	-
	X	X			X												-	-
	X	X			X												-	-
	X	X			X												-	-
	X	X			X												-	-
SiO compounds	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
SiO <sub>2</sub> compounds	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-
	X	X			X					X							-	-

Figure 1

	Compound	PECVD chemical reaction
Si Compounds	SiH <sub>4</sub> (g)	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)
	SiNH	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiNH+NH <sub>3</sub> (g)+N <sub>2</sub> (g)+O <sub>2</sub> (g)
	SiNH <sub>3</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiNH <sub>3</sub> +N <sub>2</sub> O(g)+HNO(g)
	SiN <sub>2</sub>	SiH <sub>4</sub> +2N <sub>2</sub> O(g)=SiN <sub>2</sub> +2H <sub>2</sub> O(g)+N <sub>2</sub> (g)
	SiN <sub>2</sub> H <sub>2</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiN <sub>2</sub> H <sub>2</sub> +N <sub>2</sub> O(g)+H <sub>2</sub> O(g)
	SiN <sub>2</sub> H <sub>4</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiN <sub>2</sub> H <sub>4</sub> +N <sub>2</sub> (g)+O <sub>2</sub> (g)
	SiN <sub>3</sub> H	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiN <sub>3</sub> H+NH <sub>3</sub> (g)+O <sub>2</sub> (g)
	SiN <sub>3</sub> H <sub>3</sub>	SiH <sub>4</sub> (g)+3N <sub>2</sub> O(g)=SiN <sub>3</sub> H <sub>3</sub> +HNO(g)+O <sub>2</sub> (g)+N <sub>2</sub> (g)
	SiN <sub>4</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiN <sub>4</sub> +2H <sub>2</sub> O(g)
	SiN <sub>4</sub> H <sub>2</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiN <sub>4</sub> H <sub>2</sub> +O <sub>2</sub> (g)+H <sub>2</sub> (g)
	SiN <sub>4</sub> H <sub>4</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiN <sub>4</sub> H <sub>4</sub> +O <sub>2</sub> (g)
SiO compounds	SiOH <sub>2</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiOH <sub>2</sub> +H <sub>2</sub> O(g)+2N <sub>2</sub> (g)
	SiOH <sub>4</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiOH <sub>4</sub> +N <sub>2</sub> O(g)+N <sub>2</sub> (g)
	SiONH	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiONH+N <sub>2</sub> O(g)+NH <sub>3</sub> (g)
	SiONH <sub>3</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiONH <sub>3</sub> +HNO(g)+N <sub>2</sub> (g)
	SiON <sub>2</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiON <sub>2</sub> +H <sub>2</sub> O(g)+N <sub>2</sub> (g)+H <sub>2</sub> (g)
	SiON <sub>2</sub> H <sub>2</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiON <sub>2</sub> H <sub>2</sub> +N <sub>2</sub> O(g)+H <sub>2</sub> (g)
	SiON <sub>2</sub> H <sub>4</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiON <sub>2</sub> H <sub>4</sub> +N <sub>2</sub> O(g)
	SiON <sub>3</sub> H	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiON <sub>3</sub> H+HNO(g)+H <sub>2</sub> (g)
	SiON <sub>3</sub> H <sub>3</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiON <sub>3</sub> H <sub>3</sub> +HNO(g)
	SiON <sub>4</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiON <sub>4</sub> +H <sub>2</sub> O(g)+H <sub>2</sub> (g)
	SiON <sub>4</sub> H <sub>2</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiON <sub>4</sub> H <sub>2</sub> +H <sub>2</sub> O(g)
	SiON <sub>4</sub> H <sub>4</sub>	SiH <sub>4</sub> (g)+3N <sub>2</sub> O(g)=SiON <sub>4</sub> H <sub>4</sub> +N <sub>2</sub> (g)+O <sub>2</sub> (g)
SiO <sub>2</sub> compounds	SiO <sub>2</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiO <sub>2</sub> +2H <sub>2</sub> O(g)+2N <sub>2</sub> (g)
	SiO <sub>2</sub> H <sub>2</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiO <sub>2</sub> H <sub>2</sub> +2N <sub>2</sub> (g)+H <sub>2</sub> (g)
	SiO <sub>2</sub> H <sub>4</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiO <sub>2</sub> H <sub>4</sub> +2N <sub>2</sub> (g)
	SiO <sub>2</sub> NH	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiO <sub>2</sub> NH+NH <sub>3</sub> (g)+N <sub>2</sub> (g)
	SiO <sub>2</sub> NH <sub>3</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiO <sub>2</sub> NH <sub>3</sub> +N <sub>3</sub> H(g)
	SiO <sub>2</sub> N <sub>2</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiO <sub>2</sub> N <sub>2</sub> +N <sub>2</sub> (g)+2H <sub>2</sub> (g)
	SiO <sub>2</sub> N <sub>2</sub> H <sub>2</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiO <sub>2</sub> N <sub>2</sub> H <sub>2</sub> +N <sub>2</sub> (g)+H <sub>2</sub> (g)
	SiO <sub>2</sub> N <sub>2</sub> H <sub>4</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiO <sub>2</sub> N <sub>2</sub> H <sub>4</sub> +N <sub>2</sub> (g)
	SiO <sub>2</sub> N <sub>3</sub> H	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiO <sub>2</sub> N <sub>3</sub> H+NH <sub>3</sub> (g)
	SiO <sub>2</sub> N <sub>4</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiO <sub>2</sub> N <sub>4</sub> +2H <sub>2</sub> (g)
	SiO <sub>2</sub> N <sub>4</sub> H <sub>2</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiO <sub>2</sub> N <sub>4</sub> H <sub>2</sub> +H <sub>2</sub> (g)
	SiO <sub>2</sub> N <sub>4</sub> H <sub>4</sub>	SiH <sub>4</sub> (g)+2N <sub>2</sub> O(g)=SiO <sub>2</sub> N <sub>4</sub> H <sub>4</sub>

Figure 2

	Compound	High T° thermal treatment reaction	New compound
Si compounds	SiH <sub>4</sub> (g)	SiH <sub>4</sub> +N <sub>2</sub> (g)=SiNH+NH <sub>3</sub> (g)	SiNH
	SiNH	SiNH+N <sub>2</sub> (g)=SiNH+N <sub>2</sub> (g)	SiNH
	SiNH <sub>3</sub>	SiNH <sub>3</sub> +N <sub>2</sub> (g)=SiNH+N <sub>2</sub> (g)+H <sub>2</sub> (g)	SiNH
	SiN <sub>2</sub>	SiN <sub>2</sub> +N <sub>2</sub> (g)=SiN <sub>2</sub> +N <sub>2</sub> (g)	SiN <sub>2</sub>
	SiN <sub>2</sub> H <sub>2</sub>	SiN <sub>2</sub> H <sub>2</sub> +N <sub>2</sub> (g)=SiN <sub>2</sub> +N <sub>2</sub> (g)+H <sub>2</sub> (g)	SiN <sub>2</sub>
	SiN <sub>2</sub> H <sub>4</sub>	SiN <sub>2</sub> H <sub>4</sub> +N <sub>2</sub> (g)=SiN <sub>2</sub> +N <sub>2</sub> (g)+2H <sub>2</sub> (g)	SiN <sub>2</sub>
	SiN <sub>3</sub> H	SiN <sub>3</sub> H+N <sub>2</sub> (g)=SiNH+2N <sub>2</sub> (g)	SiNH
	SiN <sub>3</sub> H <sub>3</sub>	SiN <sub>3</sub> H <sub>3</sub> +N <sub>2</sub> (g)=SiNH+2N <sub>2</sub> (g)+H <sub>2</sub> (g)	SiNH
	SiN <sub>4</sub>	SiN <sub>4</sub> +N <sub>2</sub> (g)=SiN <sub>2</sub> +2N <sub>2</sub> (g)	SiN <sub>2</sub>
	SiN <sub>4</sub> H <sub>2</sub>	SiN <sub>4</sub> H <sub>2</sub> +N <sub>2</sub> (g)=SiN <sub>2</sub> +2N <sub>2</sub> (g)+H <sub>2</sub> (g)	SiN <sub>2</sub>
	SiN <sub>4</sub> H <sub>4</sub>	SiN <sub>4</sub> H <sub>4</sub> +N <sub>2</sub> (g)=SiN <sub>2</sub> +2N <sub>2</sub> (g)+2H <sub>2</sub> (g)	SiN <sub>2</sub>
SiO compounds	SiOH <sub>2</sub>	SiOH <sub>2</sub> +N <sub>2</sub> (g)=SiOH <sub>2</sub> +N <sub>2</sub> (g)	SiOH <sub>2</sub>
	SiOH <sub>4</sub>	SiOH <sub>4</sub> +N <sub>2</sub> (g)=SiOH <sub>2</sub> +N <sub>2</sub> (g)+H <sub>2</sub> (g)	SiOH <sub>2</sub>
	SiONH	SiONH+N <sub>2</sub> (g)=SiONH+N <sub>2</sub> (g)	SiONH
	SiONH <sub>3</sub>	SiONH <sub>3</sub> +N <sub>2</sub> (g)=SiONH+N <sub>2</sub> (g)+H <sub>2</sub> (g)	SiONH
	SiON <sub>2</sub>	SiON <sub>2</sub> +N <sub>2</sub> (g)=SiON <sub>2</sub> +N <sub>2</sub> (g)	SiON <sub>2</sub>
	SiON <sub>2</sub> H <sub>2</sub>	SiON <sub>2</sub> H <sub>2</sub> +N <sub>2</sub> (g)=SiON <sub>2</sub> +N <sub>2</sub> (g)+H <sub>2</sub> (g)	SiON <sub>2</sub>
	SiON <sub>2</sub> H <sub>4</sub>	SiON <sub>2</sub> H <sub>4</sub> +N <sub>2</sub> (g)=SiON <sub>2</sub> +N <sub>2</sub> (g)+2H <sub>2</sub> (g)	SiON <sub>2</sub>
	SiON <sub>3</sub> H	SiON <sub>3</sub> H+N <sub>2</sub> (g)=SiONH+2N <sub>2</sub> (g)	SiONH
	SiON <sub>3</sub> H <sub>3</sub>	SiON <sub>3</sub> H <sub>3</sub> +N <sub>2</sub> (g)=SiONH+2N <sub>2</sub> (g)+H <sub>2</sub> (g)	SiONH
	SiON <sub>4</sub>	SiON <sub>4</sub> +N <sub>2</sub> (g)=SiON <sub>2</sub> +2N <sub>2</sub> (g)	SiON <sub>2</sub>
	SiON <sub>4</sub> H <sub>2</sub>	SiON <sub>4</sub> H <sub>2</sub> +N <sub>2</sub> (g)=SiON <sub>2</sub> +2N <sub>2</sub> (g)+H <sub>2</sub> (g)	SiON <sub>2</sub>
	SiON <sub>4</sub> H <sub>4</sub>	SiON <sub>4</sub> H <sub>4</sub> +N <sub>2</sub> (g)=SiON <sub>2</sub> +2N <sub>2</sub> (g)+2H <sub>2</sub> (g)	SiON <sub>2</sub>
SiO <sub>2</sub> compounds	SiO <sub>2</sub>	SiO <sub>2</sub> +N <sub>2</sub> (g)=SiO <sub>2</sub> +N <sub>2</sub> (g)	SiO <sub>2</sub>
	SiO <sub>2</sub> H <sub>2</sub>	SiO <sub>2</sub> H <sub>2</sub> +N <sub>2</sub> (g)=SiO <sub>2</sub> +N <sub>2</sub> (g)+H <sub>2</sub> (g)	SiO <sub>2</sub>
	SiO <sub>2</sub> H <sub>4</sub>	SiO <sub>2</sub> H <sub>4</sub> +N <sub>2</sub> (g)=SiO <sub>2</sub> +N <sub>2</sub> (g)+2H <sub>2</sub> (g)	SiO <sub>2</sub>
	SiO <sub>2</sub> NH	SiO <sub>2</sub> NH+N <sub>2</sub> (g)=SiO <sub>2</sub> NH+N <sub>2</sub> (g)	SiO <sub>2</sub>
	SiO <sub>2</sub> NH <sub>3</sub>	SiO <sub>2</sub> NH <sub>3</sub> +N <sub>2</sub> (g)=SiO <sub>2</sub> +NH <sub>3</sub> (g)+N <sub>2</sub> (g)	SiO <sub>2</sub>
	SiO <sub>2</sub> N <sub>2</sub>	SiO <sub>2</sub> N <sub>2</sub> +N <sub>2</sub> (g)=SiO <sub>2</sub> +2N <sub>2</sub> (g)	SiO <sub>2</sub>
	SiO <sub>2</sub> N <sub>2</sub> H <sub>2</sub>	SiO <sub>2</sub> N <sub>2</sub> H <sub>2</sub> +N <sub>2</sub> (g)=SiO <sub>2</sub> +2N <sub>2</sub> (g)+H <sub>2</sub> (g)	SiO <sub>2</sub>
	SiO <sub>2</sub> N <sub>2</sub> H <sub>4</sub>	SiO <sub>2</sub> N <sub>2</sub> H <sub>4</sub> +N <sub>2</sub> (g)=SiO <sub>2</sub> +2N <sub>2</sub> (g)+2H <sub>2</sub> (g)	SiO <sub>2</sub>
	SiO <sub>2</sub> N <sub>3</sub> H	SiO <sub>2</sub> N <sub>3</sub> H+N <sub>2</sub> (g)=SiO <sub>2</sub> NH+2N <sub>2</sub> (g)	SiO <sub>2</sub>
	SiO <sub>2</sub> N <sub>4</sub>	SiO <sub>2</sub> N <sub>4</sub> +N <sub>2</sub> (g)=SiO <sub>2</sub> +3N <sub>2</sub> (g)	SiO <sub>2</sub>
	SiO <sub>2</sub> N <sub>4</sub> H <sub>2</sub>	SiO <sub>2</sub> N <sub>4</sub> H <sub>2</sub> +N <sub>2</sub> (g)=SiO <sub>2</sub> +3N <sub>2</sub> (g)+H <sub>2</sub> (g)	SiO <sub>2</sub>
	SiO <sub>2</sub> N <sub>4</sub> H <sub>4</sub>	SiO <sub>2</sub> N <sub>4</sub> H <sub>4</sub> +N <sub>2</sub> (g)=SiO <sub>2</sub> +3N <sub>2</sub> (g)+2H <sub>2</sub> (g)	SiO <sub>2</sub>

Figure 3

		HO-H	SiO-H	SiN-H	SiN-H	Si-H	Si=O	N=N	Si-O-Si	Si-O-Si	Si-ON	Si-OH	Si-O-Si	Si-O-Si	
FTIR	1st mode (cm <sup>-1</sup> )	Min	3550	3470	3380	3300	2210	1800	1530	1080	1000	910	860	740	410
	Ave	3650	3510	3420	3380	2260	1875	1555	1180	1080	950	885	810	460	
	Max	3750	3550	3460	3460	2310	1950	1580	1280	1160	990	910	880	510	
1st mode (μm)	Min	2.817	2.882	2.959	3.030	4.525	5.556	6.536	9.259	10.000	10.989	11.628	13.514	24.390	
	Ave	2.740	2.849	2.924	2.959	4.425	5.333	6.431	8.475	9.259	10.526	11.299	12.346	21.739	
	Max	2.667	2.817	2.890	2.890	4.329	5.128	6.329	7.813	8.621	10.101	10.989	11.364	19.608	
2nd mode (μm)	Min	1.408	1.441	1.479	1.515	2.262	2.778	3.268	4.630	5.000	5.495	5.814	6.757	12.195	
	Ave	1.370	1.425	1.462	1.479	2.212	2.667	3.215	4.237	4.630	5.263	5.650	6.173	10.870	
	Max	1.333	1.408	1.445	1.445	2.165	2.564	3.165	3.906	4.310	5.051	5.495	5.682	9.804	
3rd mode (μm)	Min	0.939	0.961	0.986	1.010	1.508	1.852	2.179	3.086	3.333	3.663	3.876	4.505	8.130	
	Ave	0.913	0.950	0.975	0.986	1.475	1.778	2.144	2.825	3.086	3.509	3.766	4.115	7.246	
	Max	0.889	0.939	0.963	0.963	1.443	1.709	2.110	2.604	2.874	3.367	3.663	3.788	6.536	
4th mode (μm)	Min	0.704	0.720	0.740	0.758	1.131	1.389	1.634	2.315	2.500	2.747	2.907	3.378	6.098	
	Ave	0.685	0.712	0.731	0.740	1.106	1.333	1.608	2.119	2.315	2.632	2.825	3.086	5.435	
	Max	0.667	0.704	0.723	0.723	1.082	1.282	1.582	1.953	2.155	2.525	2.747	2.841	4.902	
5th mode (μm)	Min	0.563	0.576	0.592	0.606	0.905	1.111	1.307	1.852	2.000	2.198	2.326	2.703	4.878	
	Ave	0.548	0.570	0.585	0.592	0.885	1.067	1.286	1.695	1.852	2.105	2.260	2.469	4.348	
	Max	0.533	0.563	0.578	0.578	0.866	1.026	1.266	1.563	1.724	2.020	2.198	2.273	3.922	
6th mode (μm)	Min	0.469	0.480	0.493	0.505	0.754	0.926	1.089	1.543	1.667	1.832	1.938	2.252	4.065	
	Ave	0.457	0.475	0.487	0.493	0.737	0.889	1.072	1.412	1.543	1.754	1.883	2.058	3.623	
	Max	0.444	0.469	0.482	0.482	0.722	0.855	1.055	1.302	1.437	1.684	1.832	1.894	3.268	
7th mode (μm)	Min	0.402	0.412	0.423	0.433	0.646	0.794	0.934	1.323	1.429	1.570	1.661	1.931	3.484	
	Ave	0.391	0.407	0.418	0.423	0.632	0.762	0.919	1.211	1.323	1.504	1.614	1.764	3.106	
	Max	0.381	0.402	0.413	0.413	0.618	0.733	0.904	1.116	1.232	1.443	1.570	1.623	2.801	
8th mode (μm)	Min	0.352	0.360	0.370	0.379	0.566	0.694	0.817	1.157	1.250	1.374	1.453	1.689	3.049	
	Ave	0.342	0.356	0.365	0.370	0.553	0.667	0.804	1.059	1.157	1.316	1.412	1.543	2.717	
	Max	0.333	0.352	0.361	0.361	0.541	0.641	0.791	0.977	1.078	1.263	1.374	1.420	2.451	

Figure 4

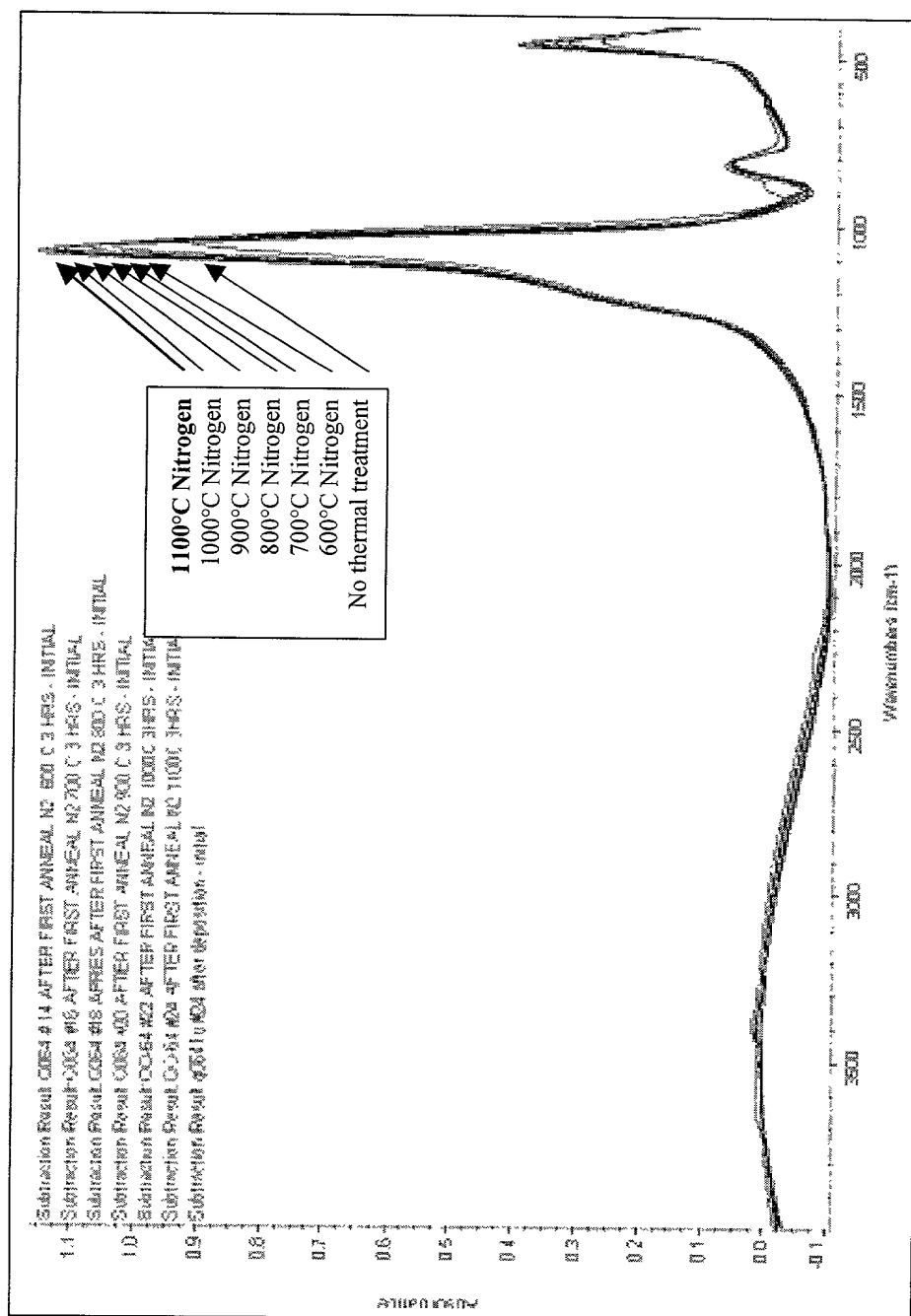
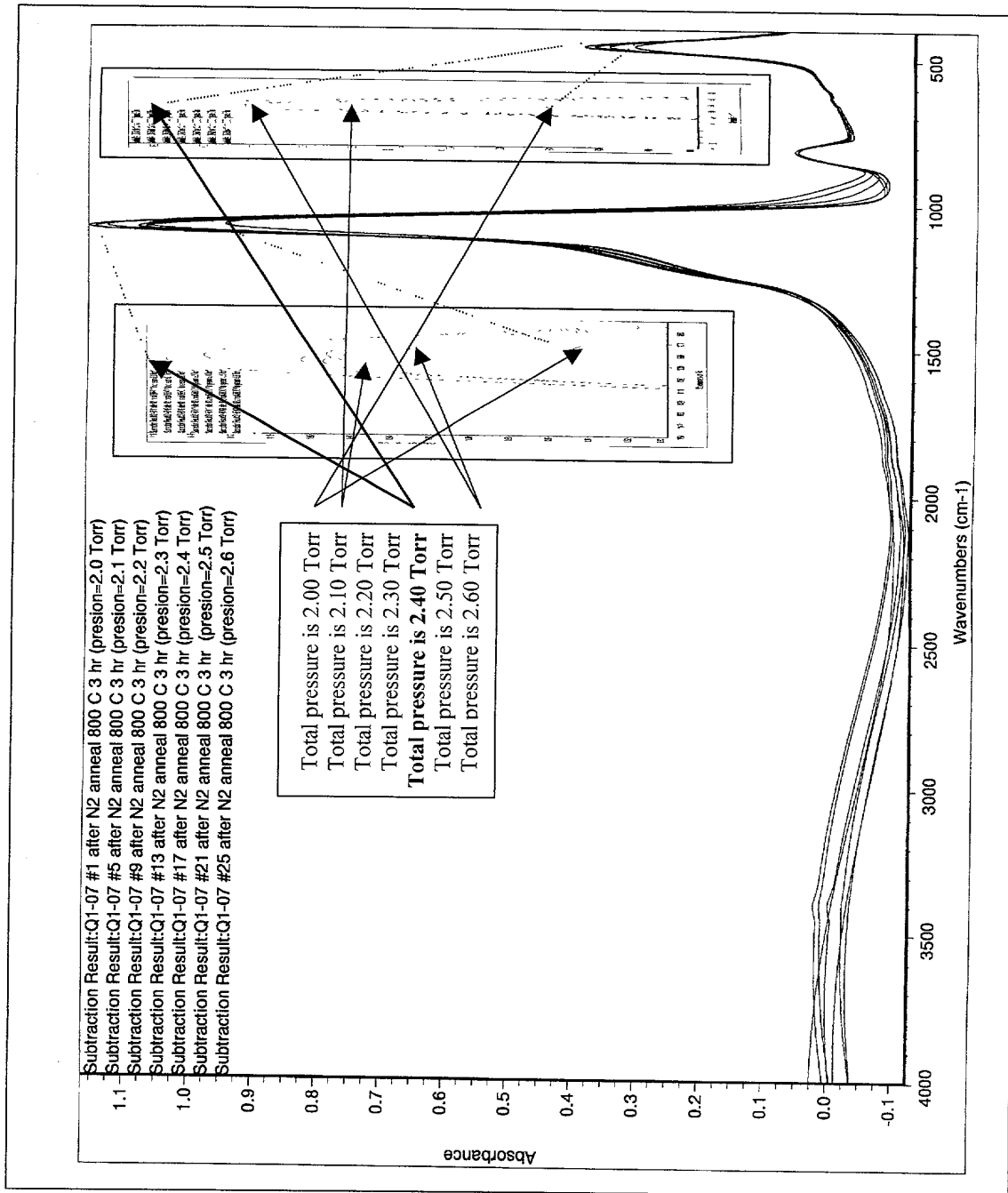


Figure 5a



**Figure 5b**

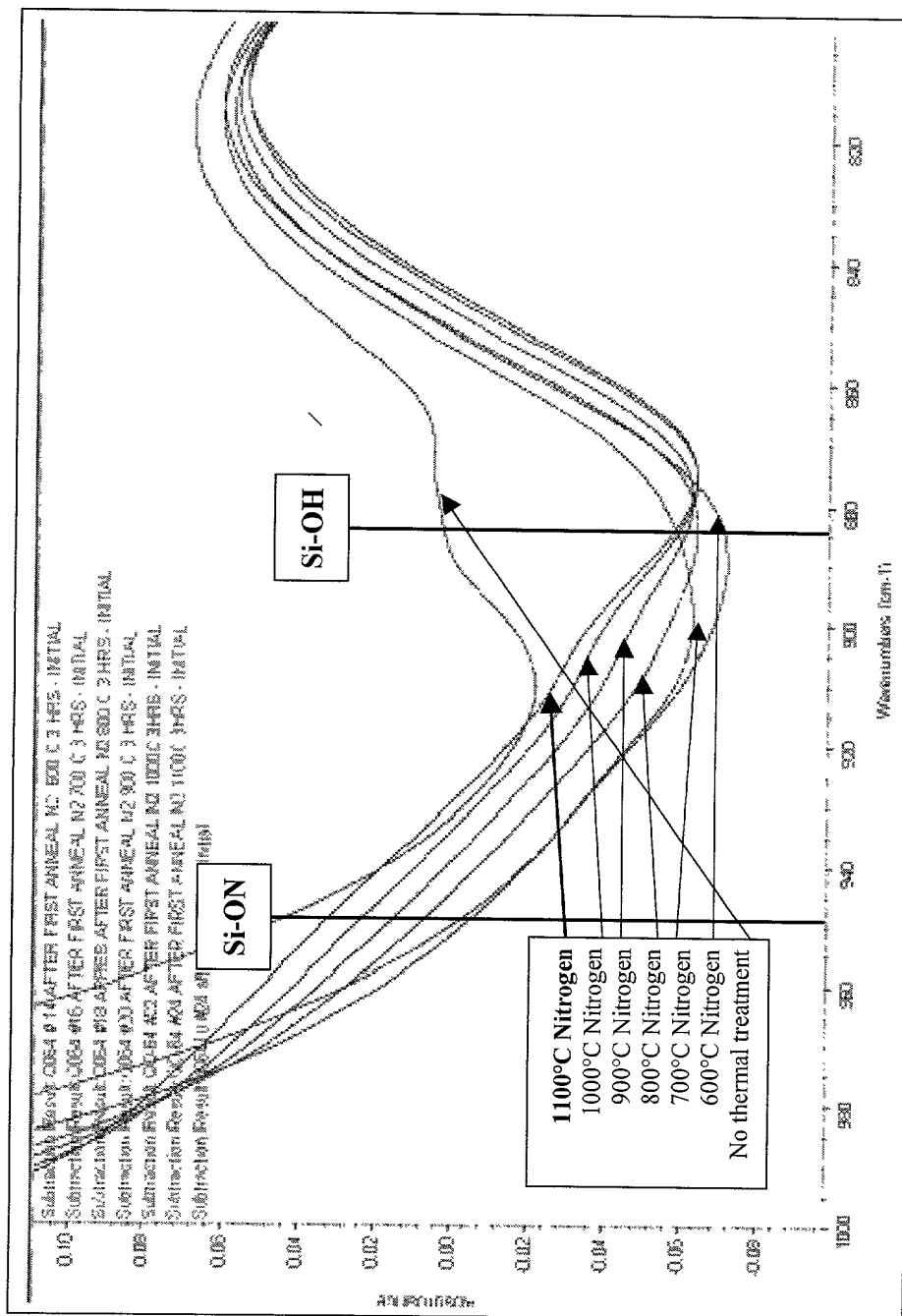
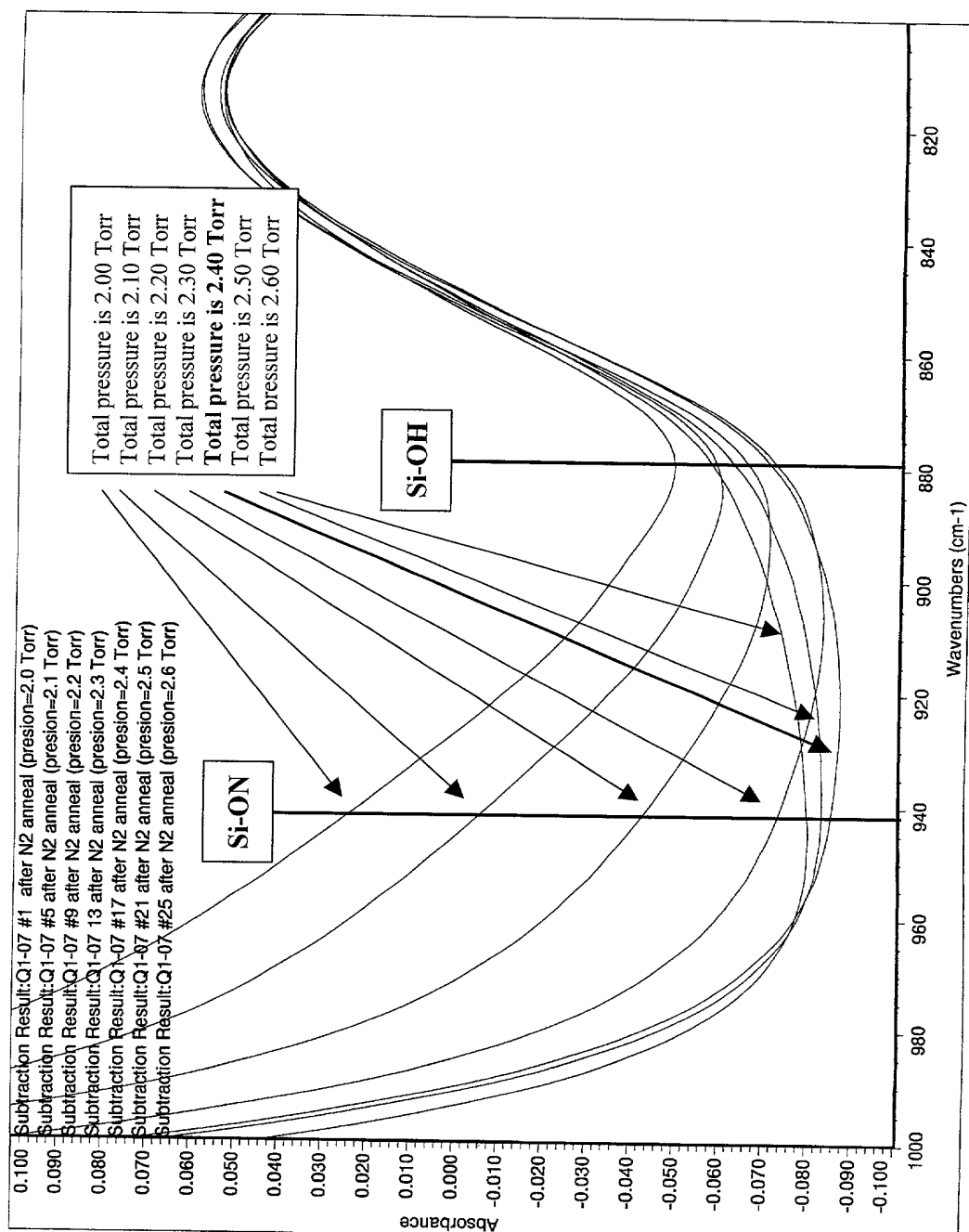


Figure 6a



**Figure 6b**



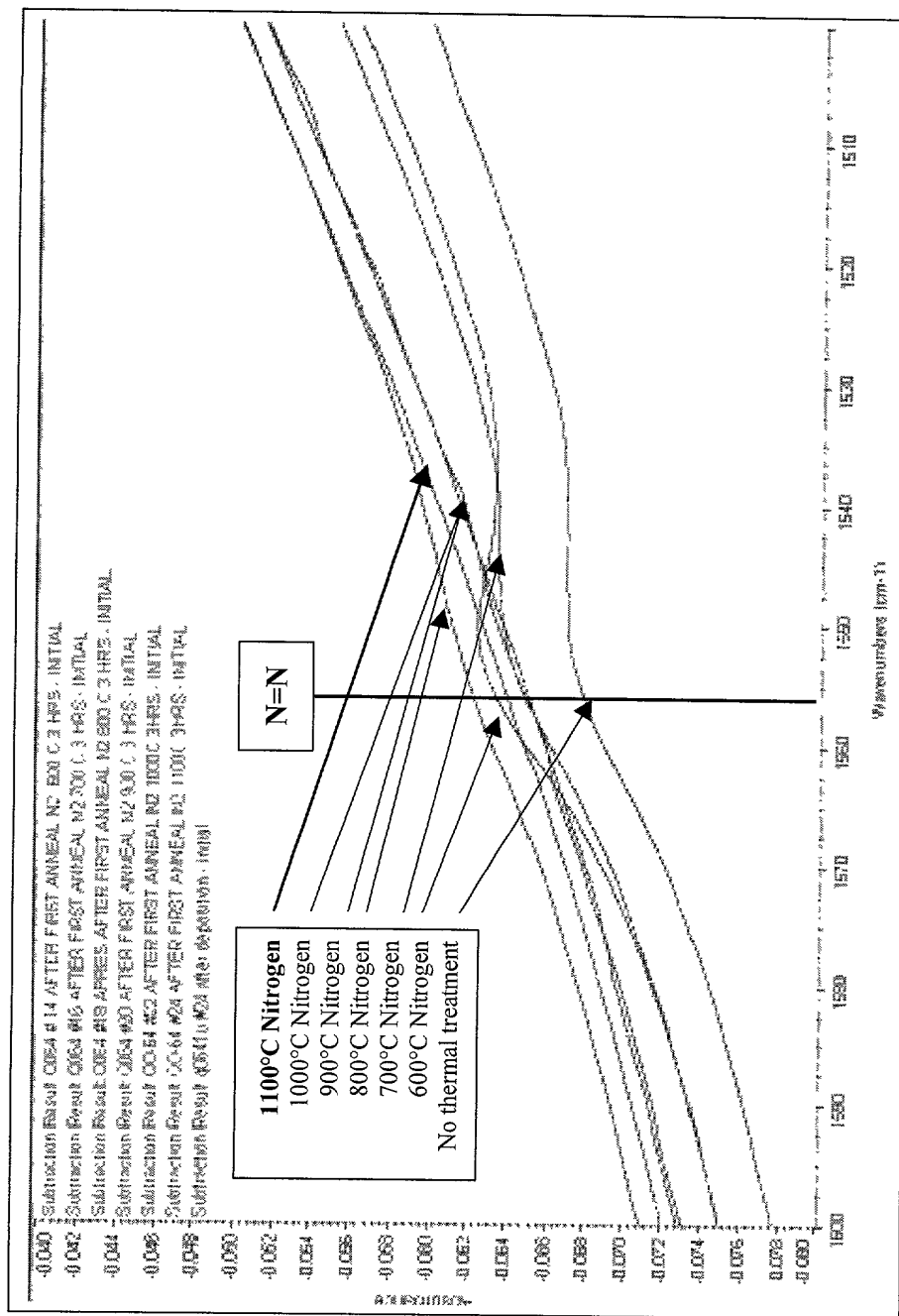
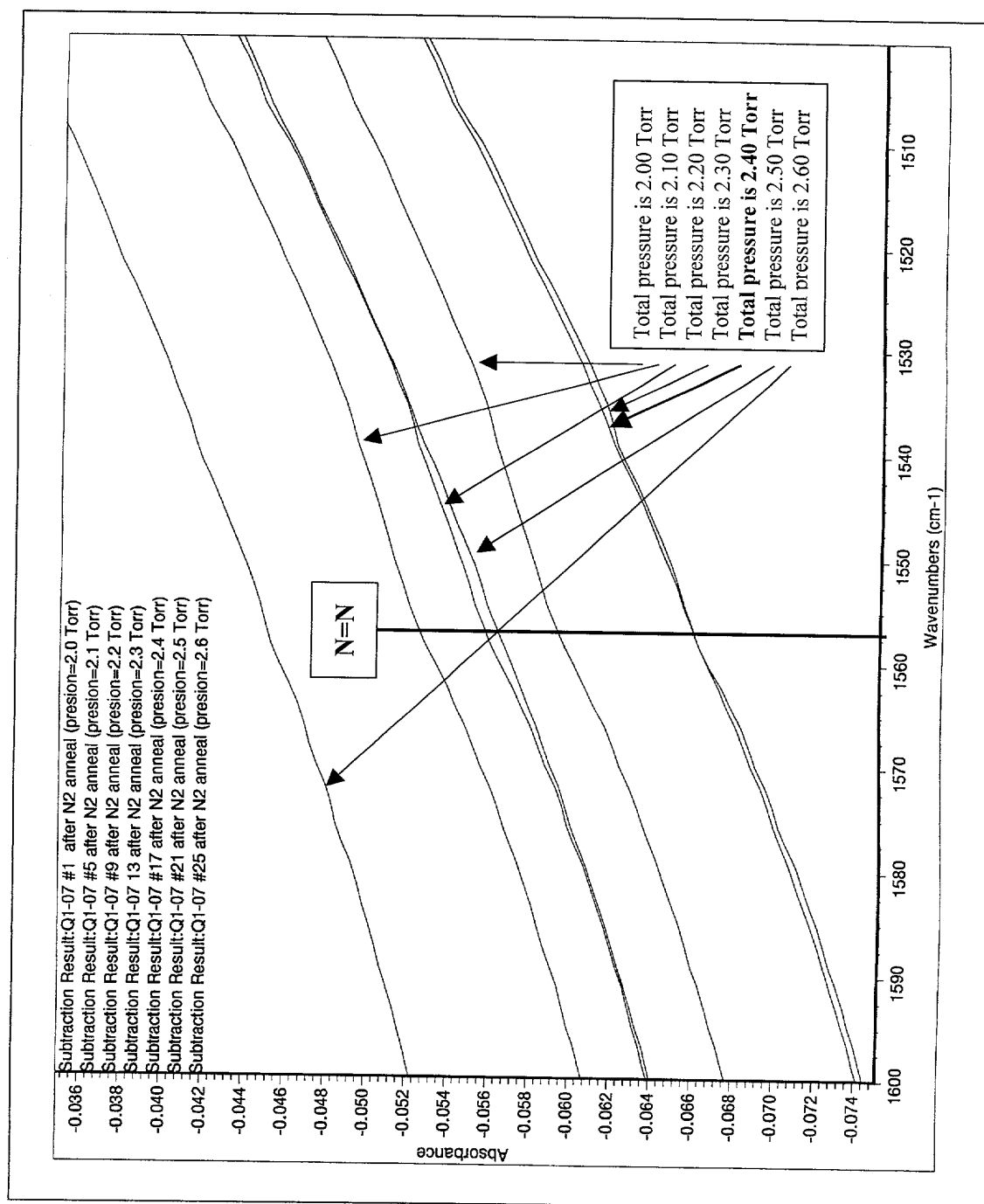


Figure 7a



**Figure 7b**

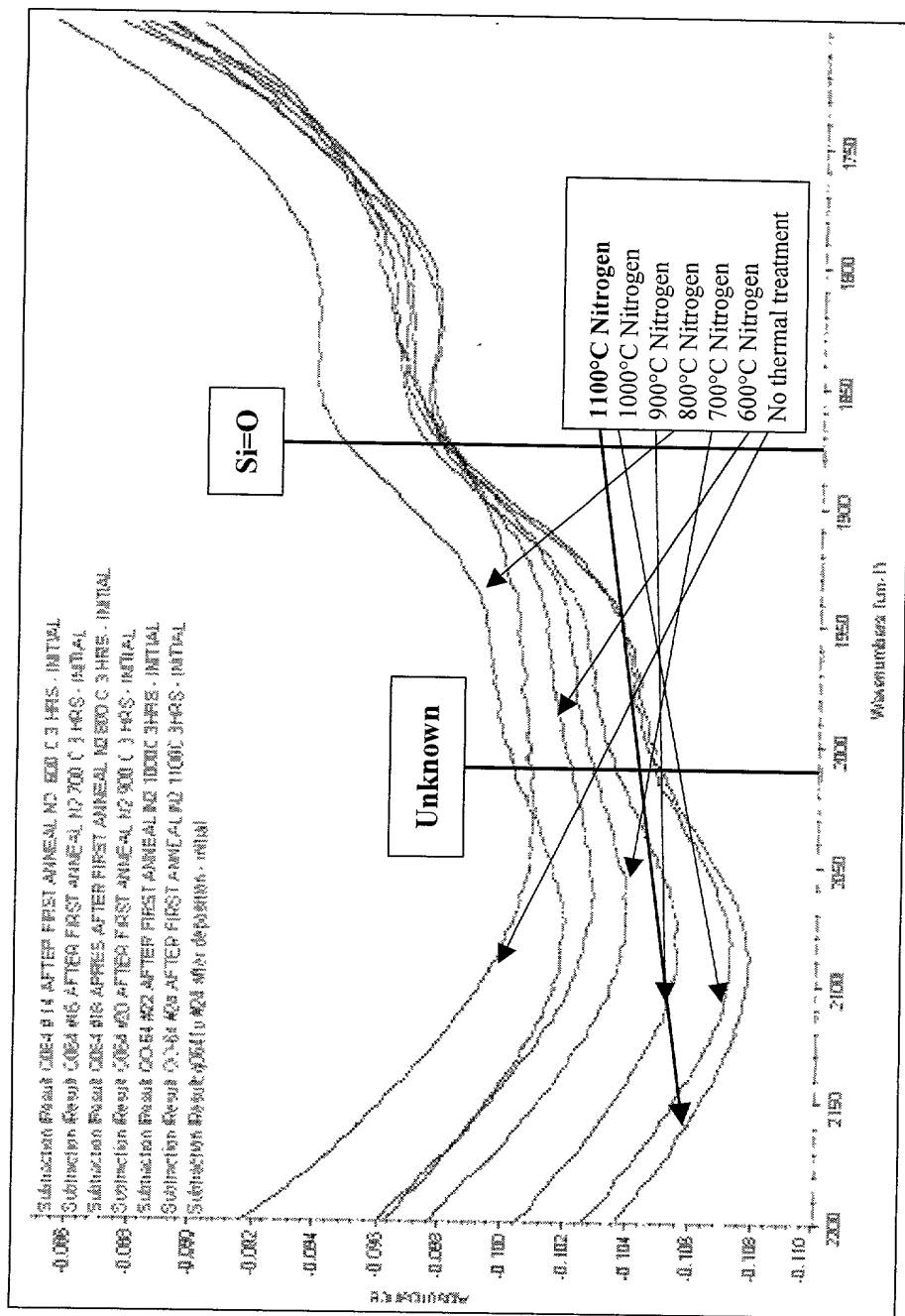


Figure 8a

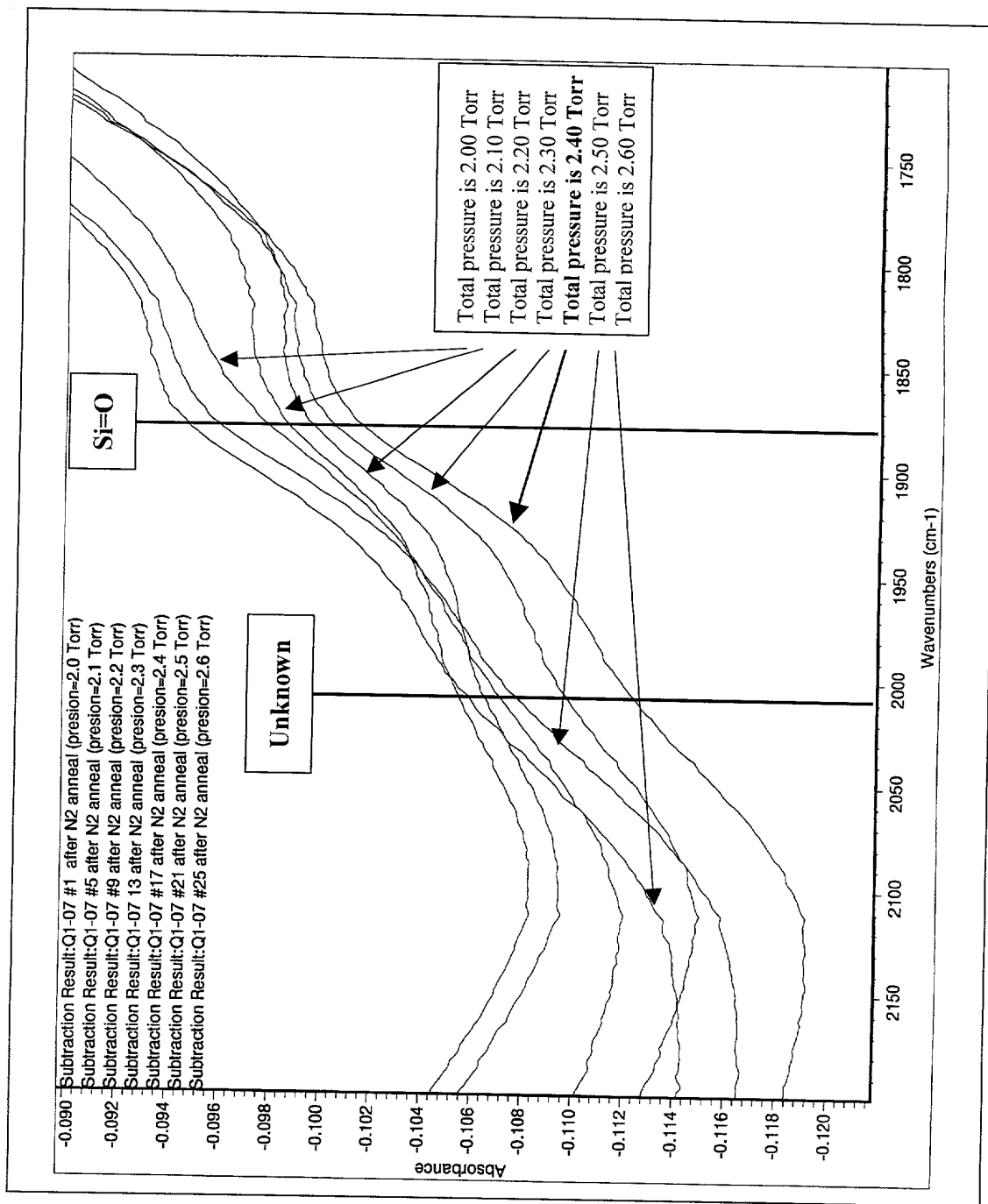
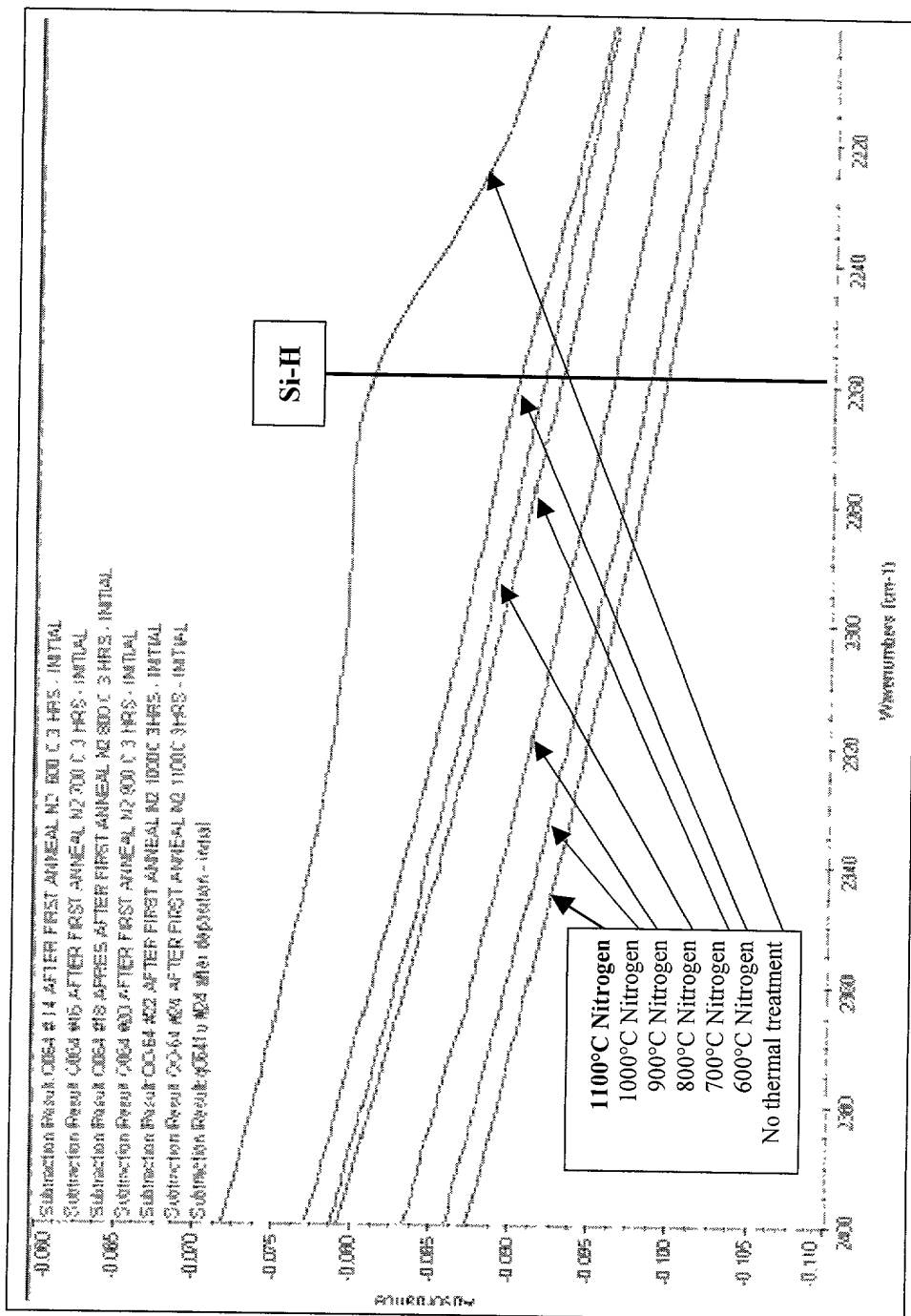


Figure 8b



**Figure 9a**

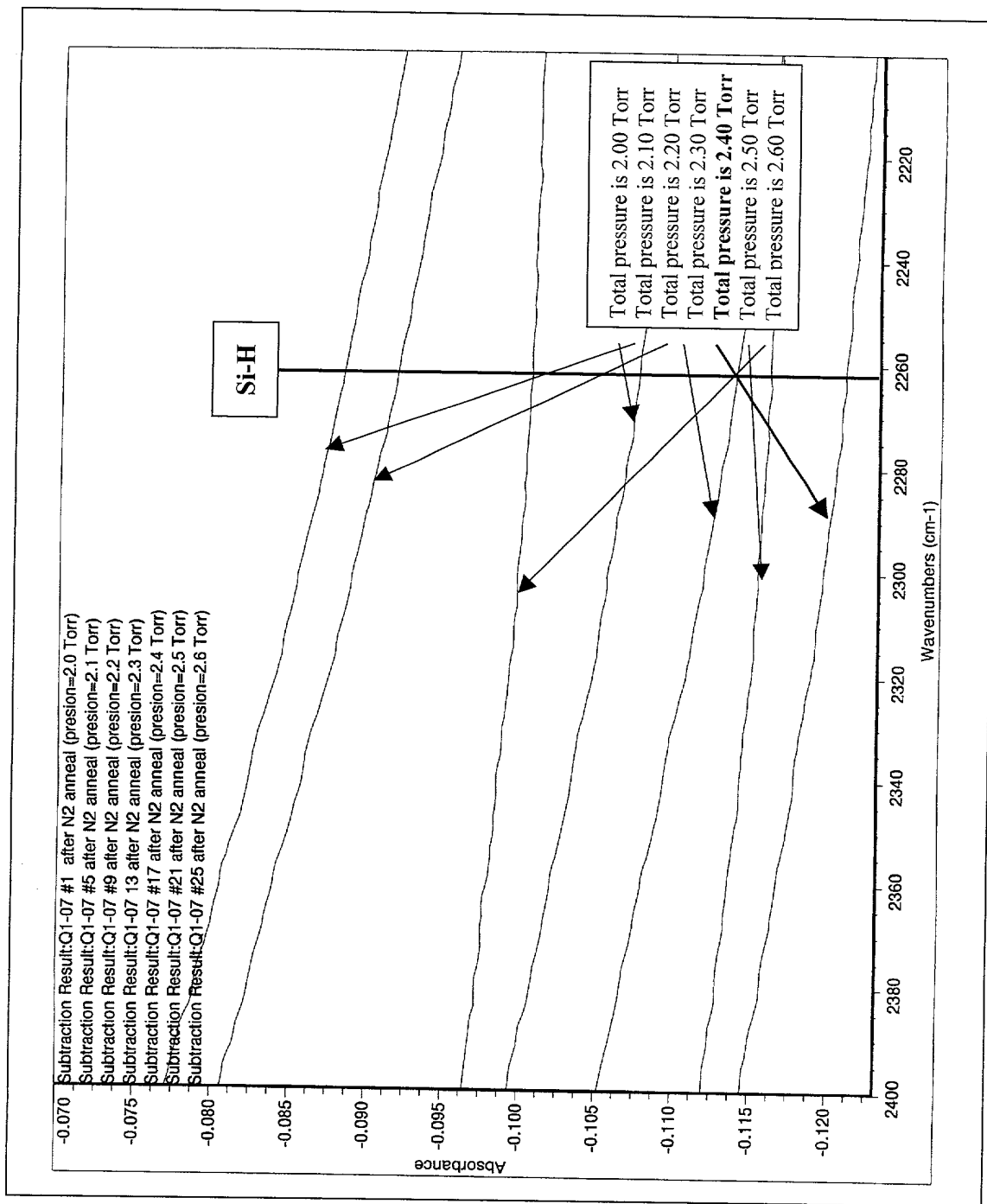


Figure 9b

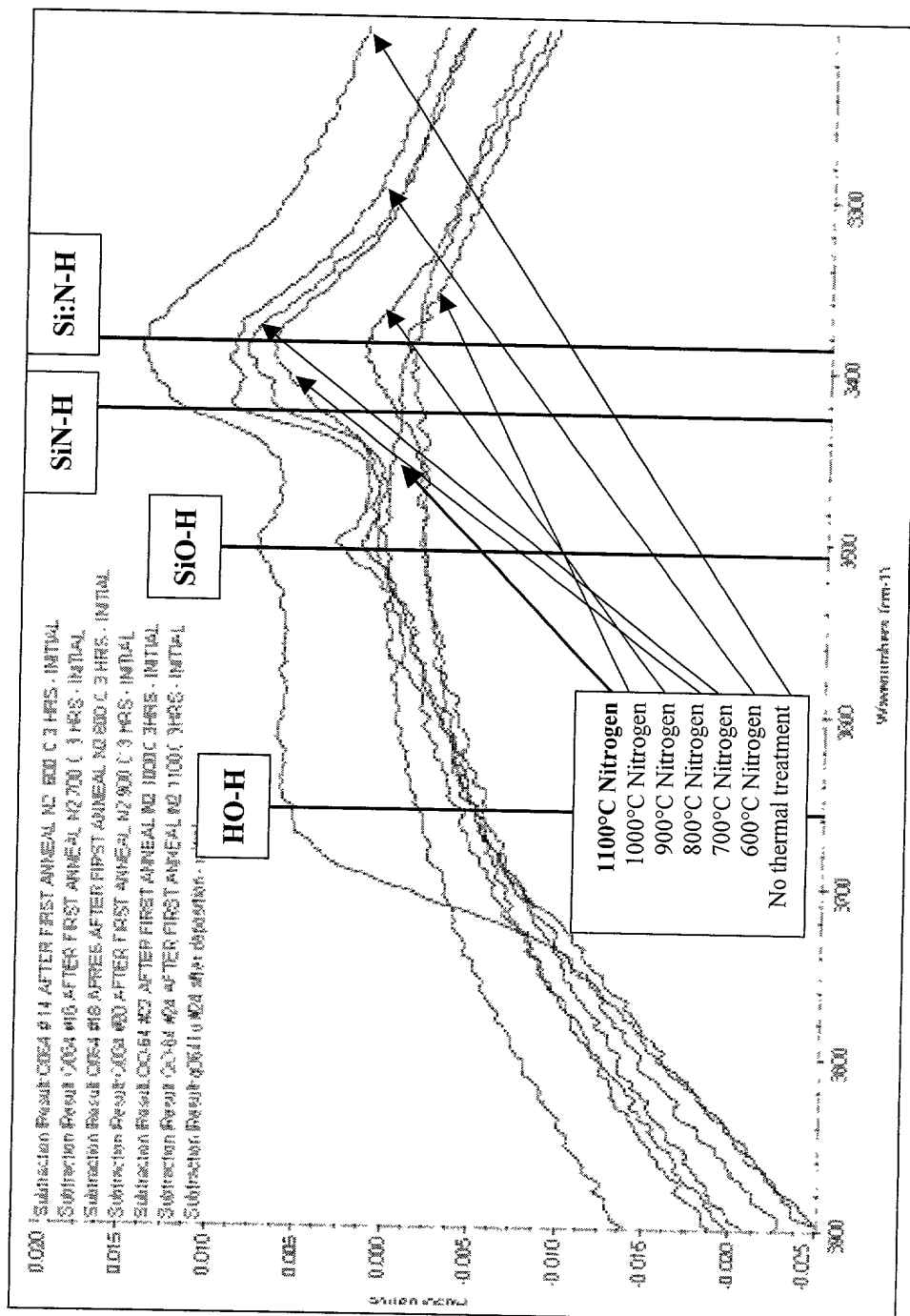


Figure 10a

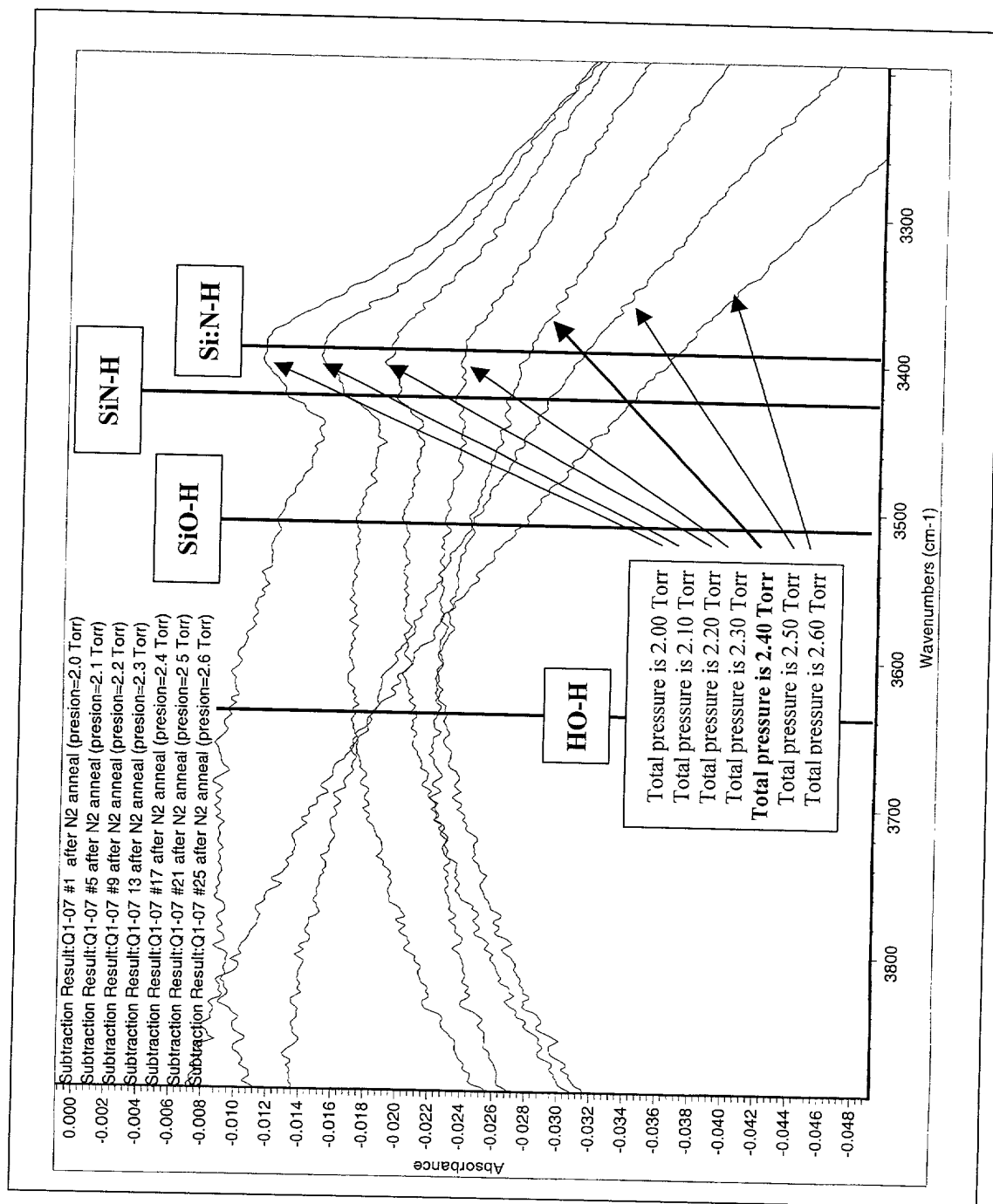
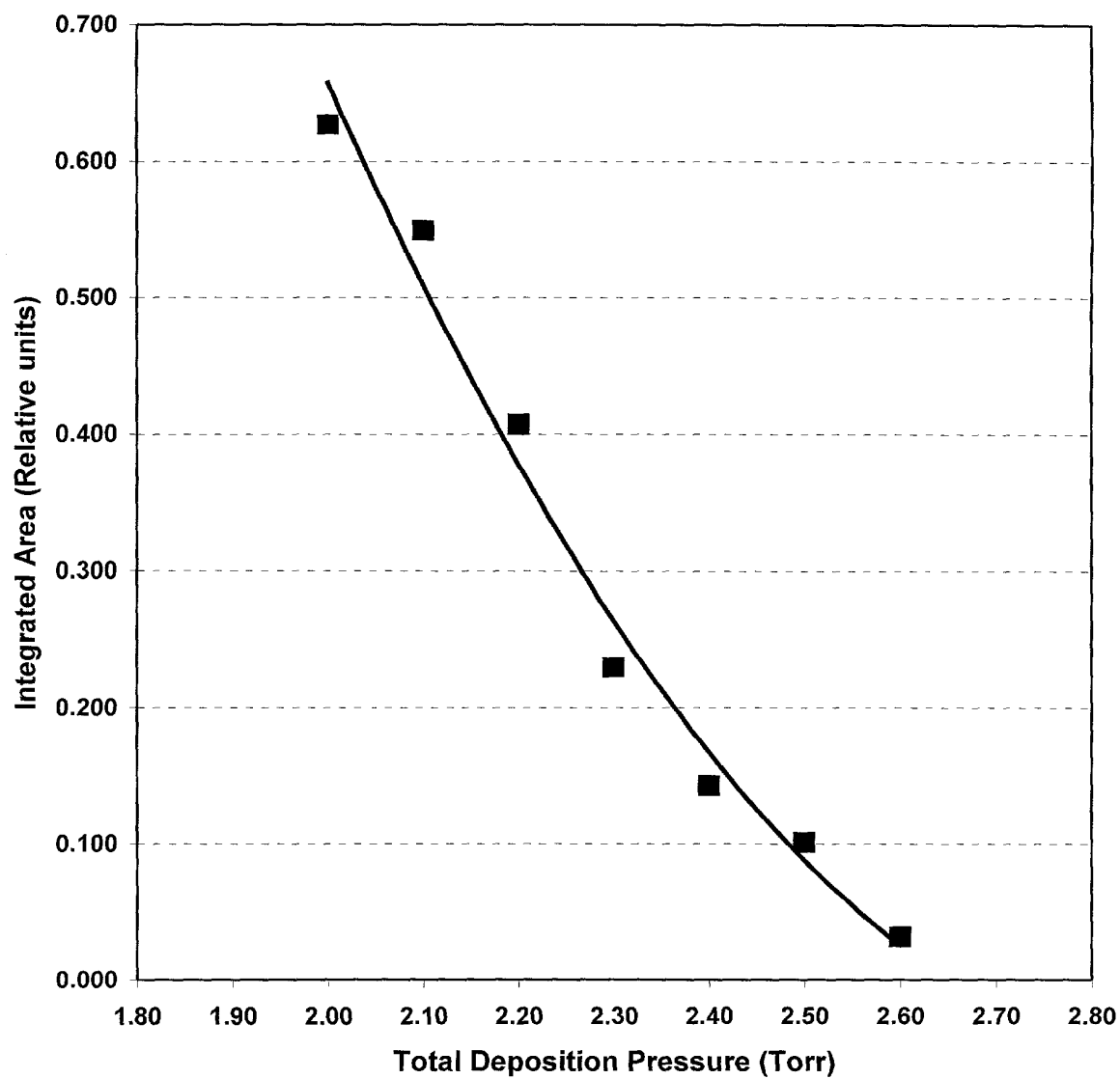


Figure 10b



Figure 11 shows the integrated area (relative units) versus total deposition pressure (Torr). The integrated area decreases as the total deposition pressure increases. The data points are as follows:



**Figure 11**

Figure 12: Refractive Index vs. Total Deposition Pressure

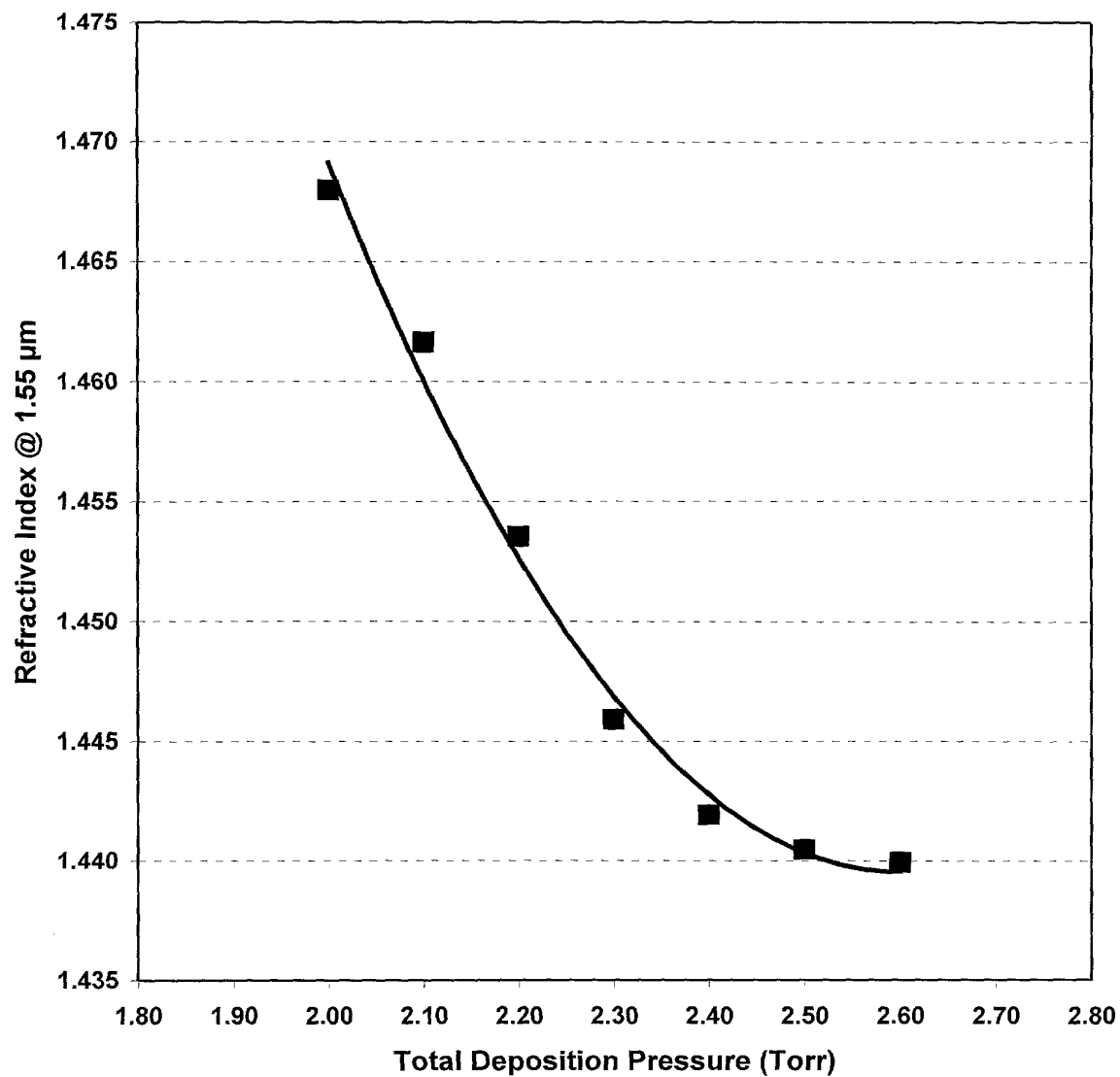


Figure 12

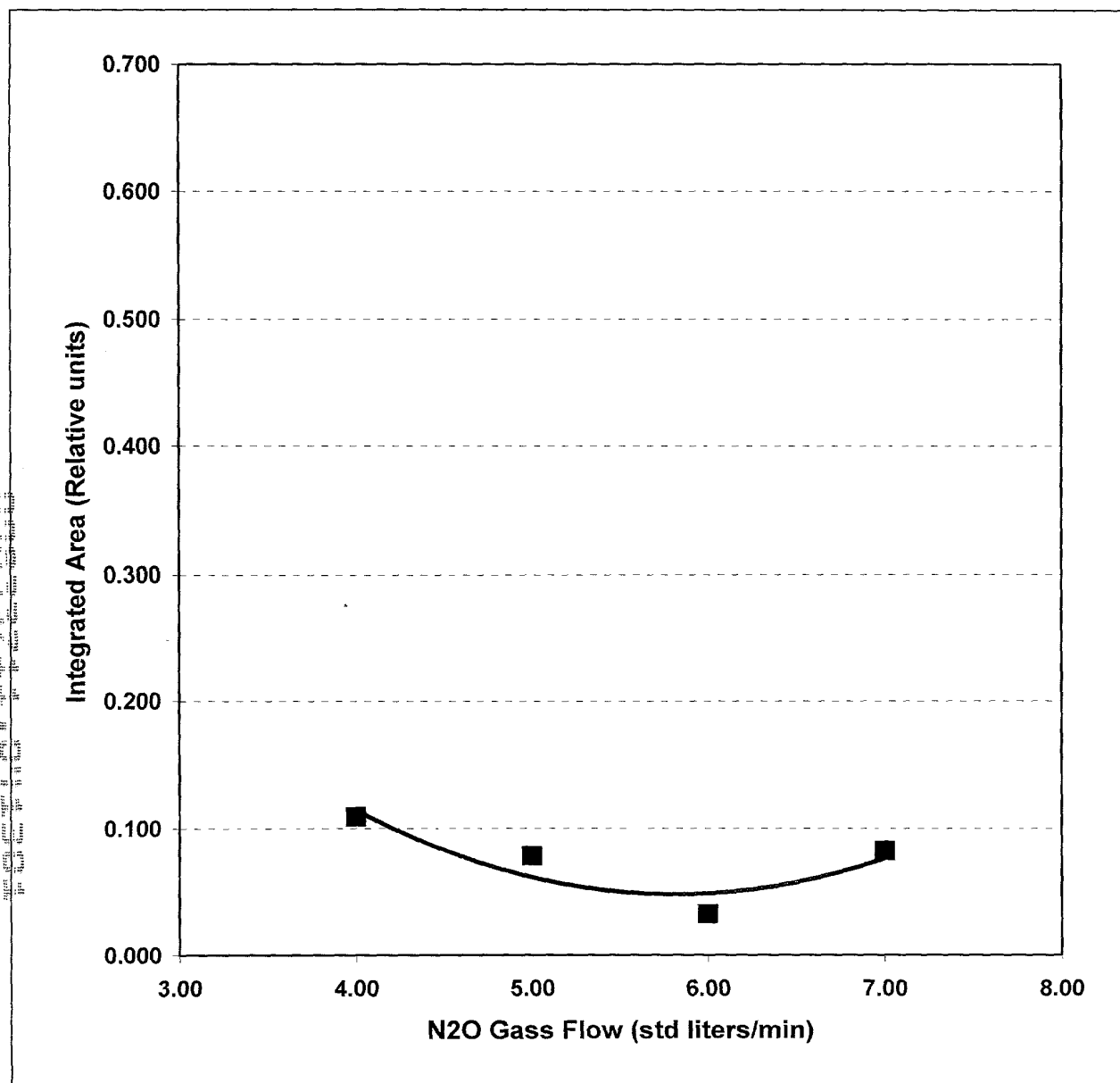
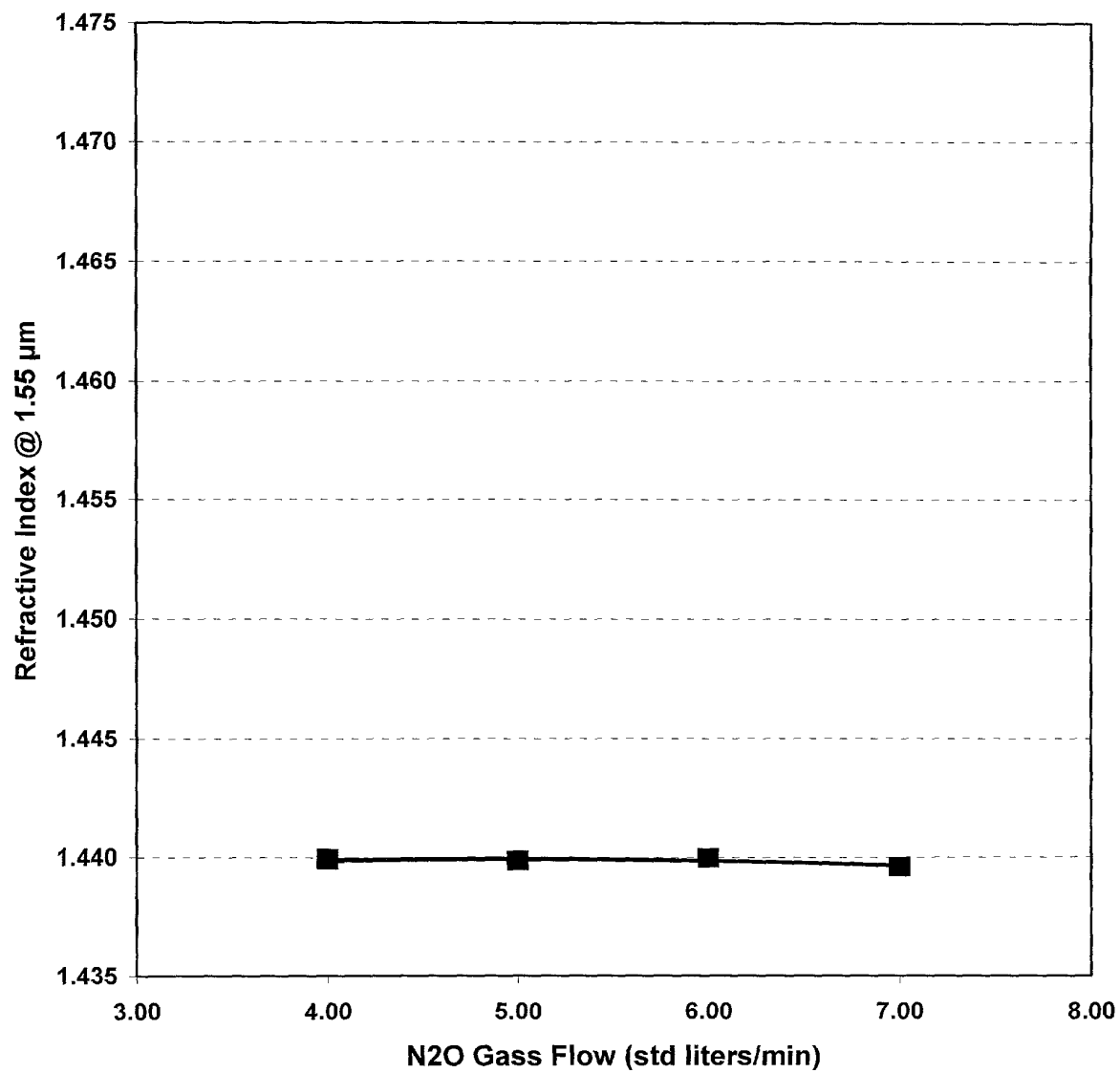


Figure 13



**Figure 14**